Skill in simulating cloud properties in a perturbed physics ensemble and the relation to model errors on short time scales

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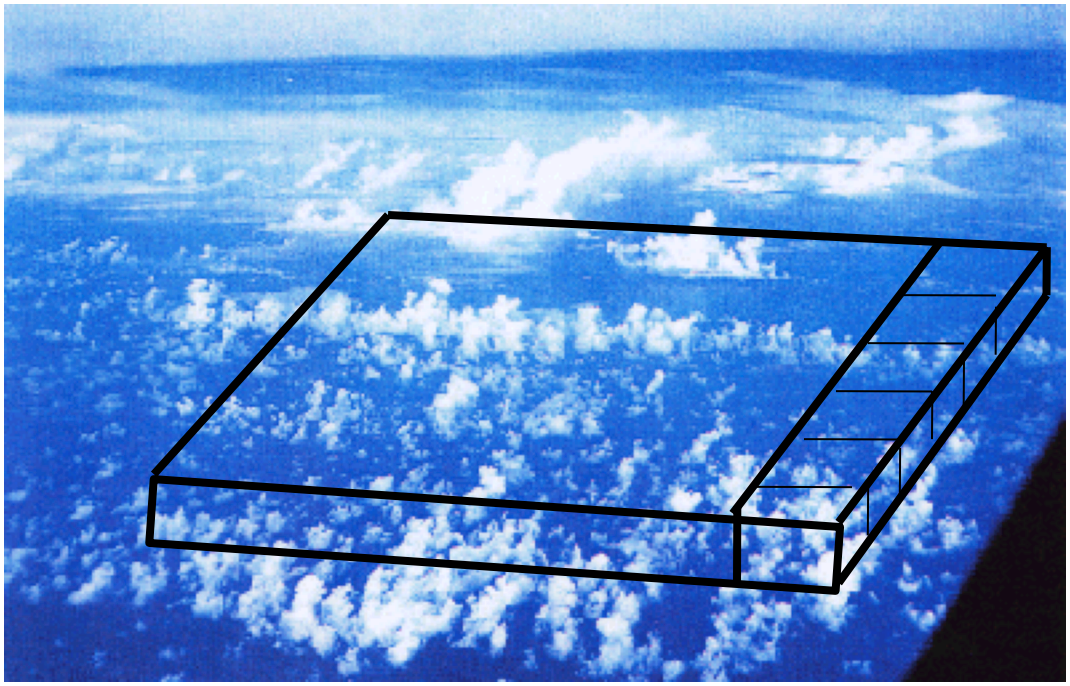
Outline

- **Motivation**
- **Perturbed physics ensemble**
- **Skill scores for clouds**
- **Data assimilation to asses fast evolving errors**
- **Is there a link?**

Motivation



A. Tompkins

GCM grid size 10s-100s Km

Perturbed parameter

CODE	Description
ENTRSCV	Entrainment rate for shallow convection [Tiedtke, 1989]
ENTRPEN	Entrainment rate for penetrative convection [Tiedtke, 1989]
CMFCTOP	Cloud mass flux above non-buoyancy level [Tiedtke, 1989]
ZASIC	Correction to asymmetry parameter of ice clouds [Stephens et al. 1990]
ZINHOML	Inhomogeneity of liquid clouds [Cahalan et al. 1994]
ZINHOMI	Inhomogeneity of ice clouds [Cahalan et al. 1994]
CPRCON	Conversion efficiency of cloud water to precipitation [Tiedtke, 1989]

Gpicmea	Gravity wave drag activation threshold (peak-mean)
Gstd	Gravity wave drag activation threshold (Standard deviation)
Dampth	Coefficient for horizontal diffusion
Calbmni	Albedo minimum (glacier, snow on ice)
Calbmns	Albedo maximum (glacier, snow on ice)
Calbmxs	Albedo minimum (bare sea ice)
Calbmxi	Albedo maximum (bare sea ice)

Skill measures

Following Pincus et al. 2008
Bias
Ratio of standard deviation (> 1 if model too variable)
Root mean square
Correlation

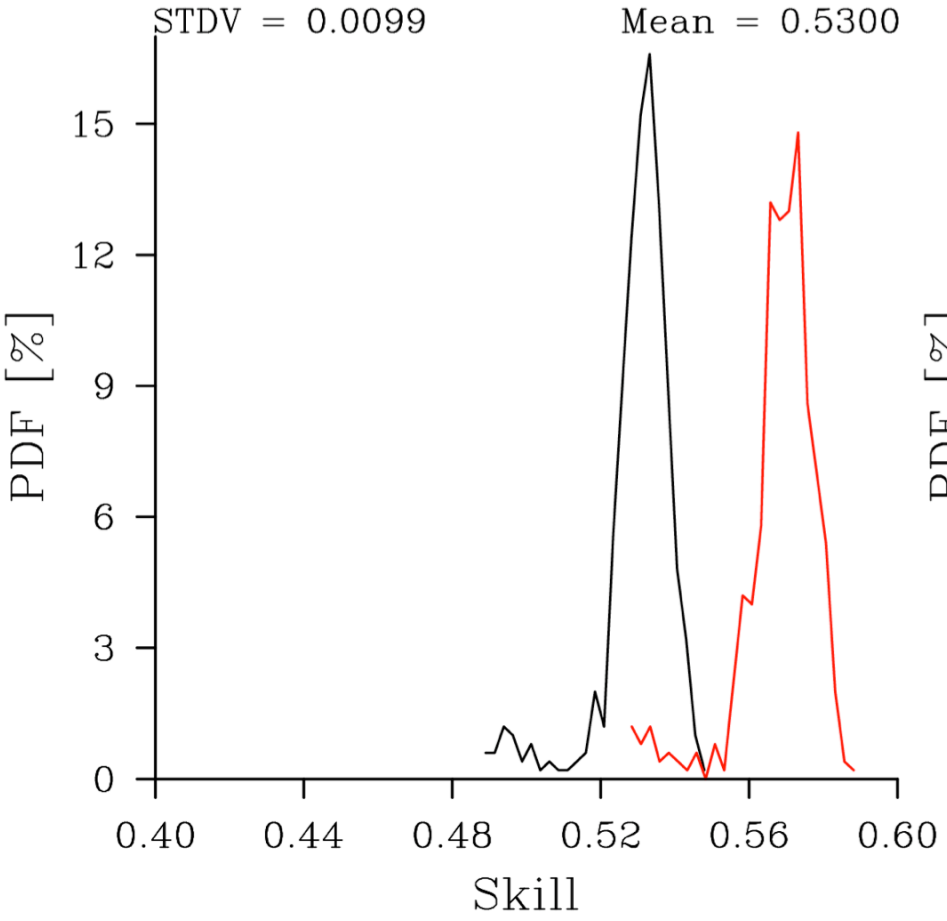
SW cloud radiative effect ($SW_{CRE} = SW_{tot,ToA} - SW_{clr,ToA}$)
LW cloud radiative effect ($LW_{CRE} = LW_{tot,ToA} - LW_{clr,ToA}$)
Cloud cover
Precipitation

2.5° x 2.5° climatological monthly means

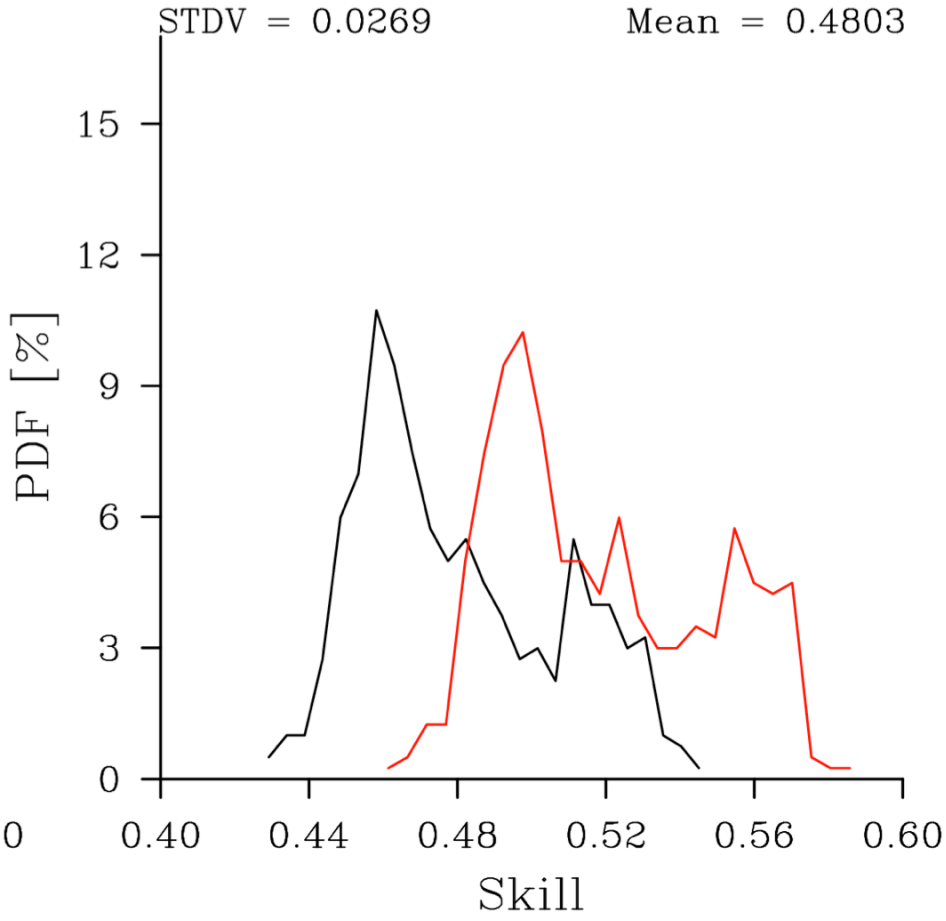
Variable	Observation #1	Observation #2
Short wave cloud radiative effect	CERES	ERBE
Long wave cloud radiative effect	CERES	ERBE
Cloud cover	ISCCP-2D	MODIS
Precipitation	GPCP	CMAP

What range of skills do we sample?

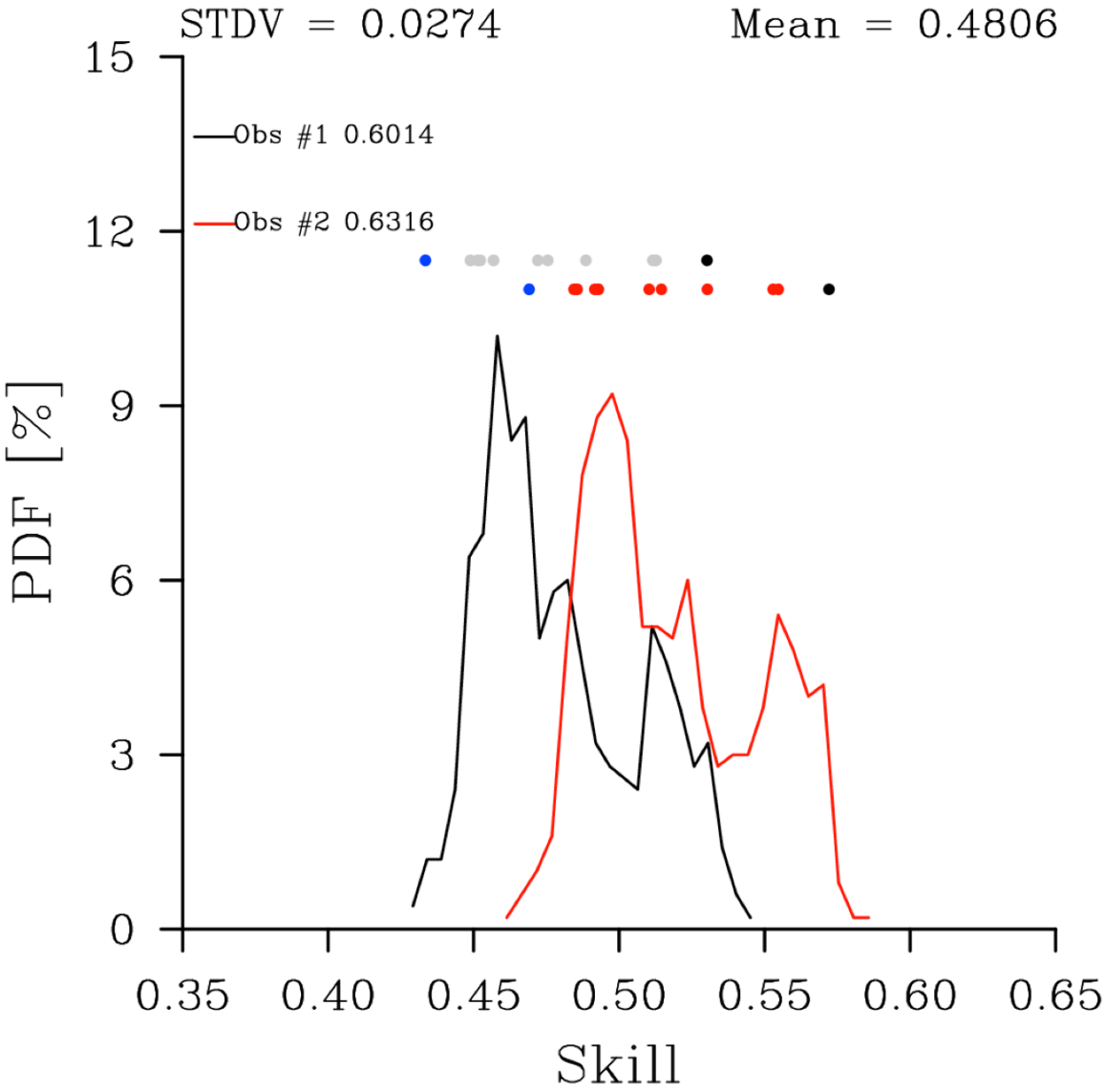
Single parameter varied



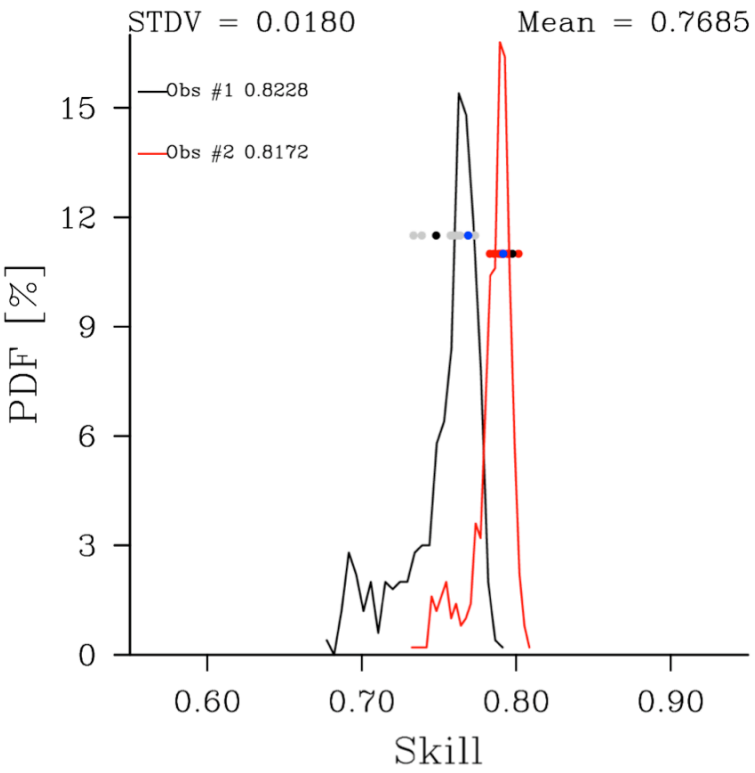
All parameters varied (latin hypercube)



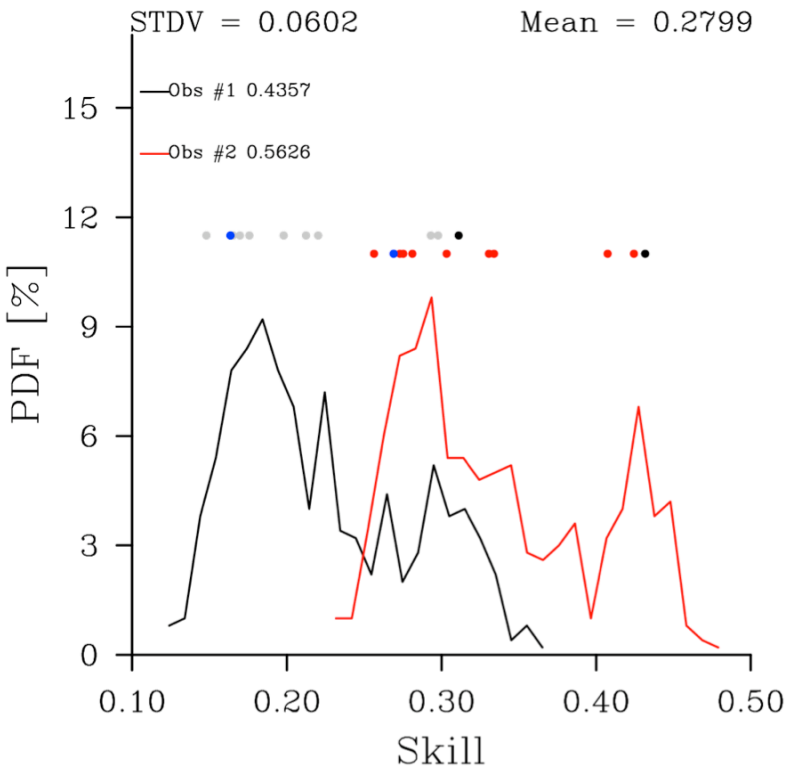
Combined skill



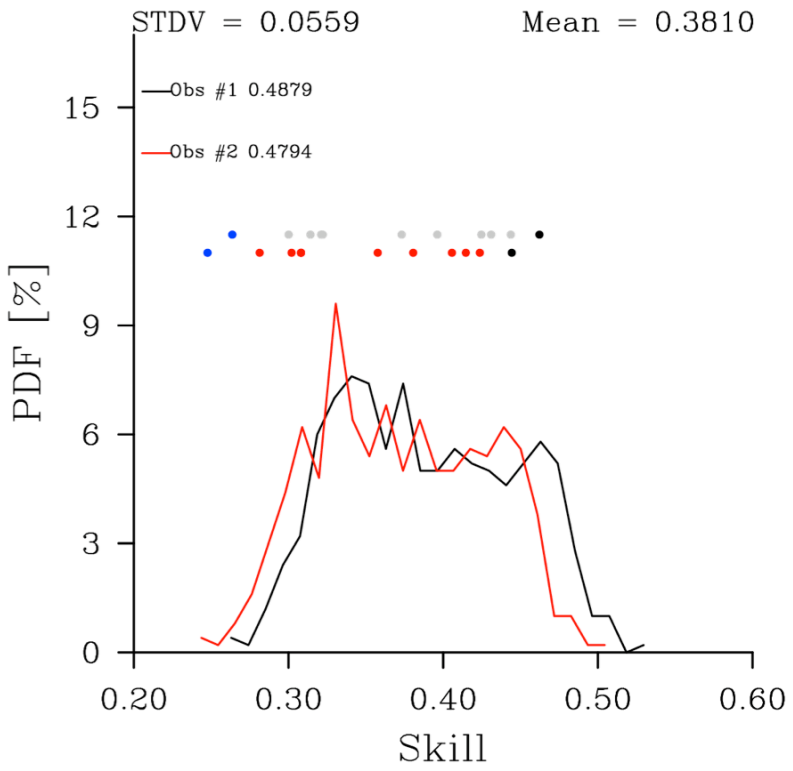
Cloud cover



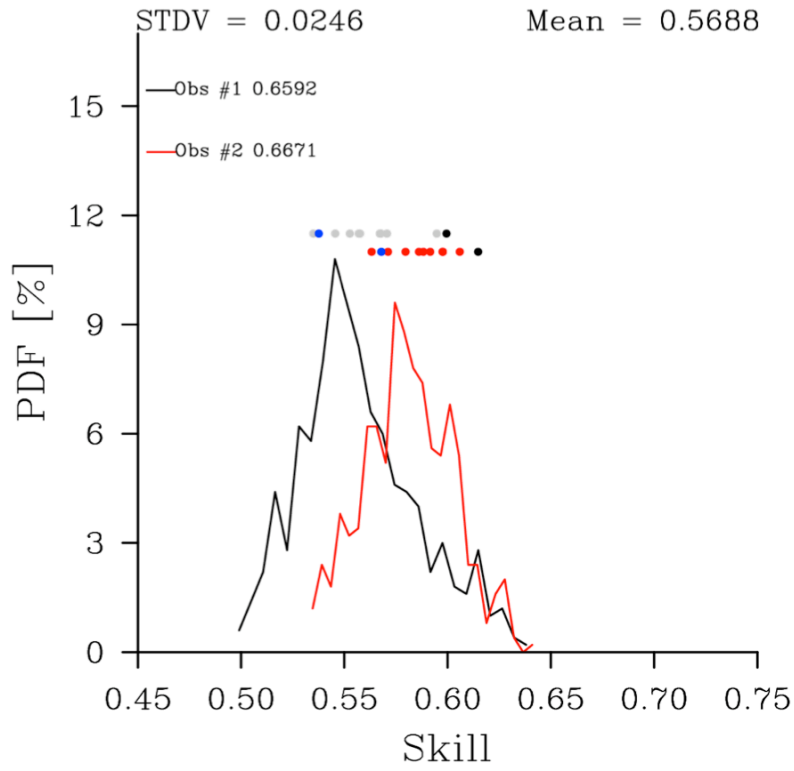
Precipitation



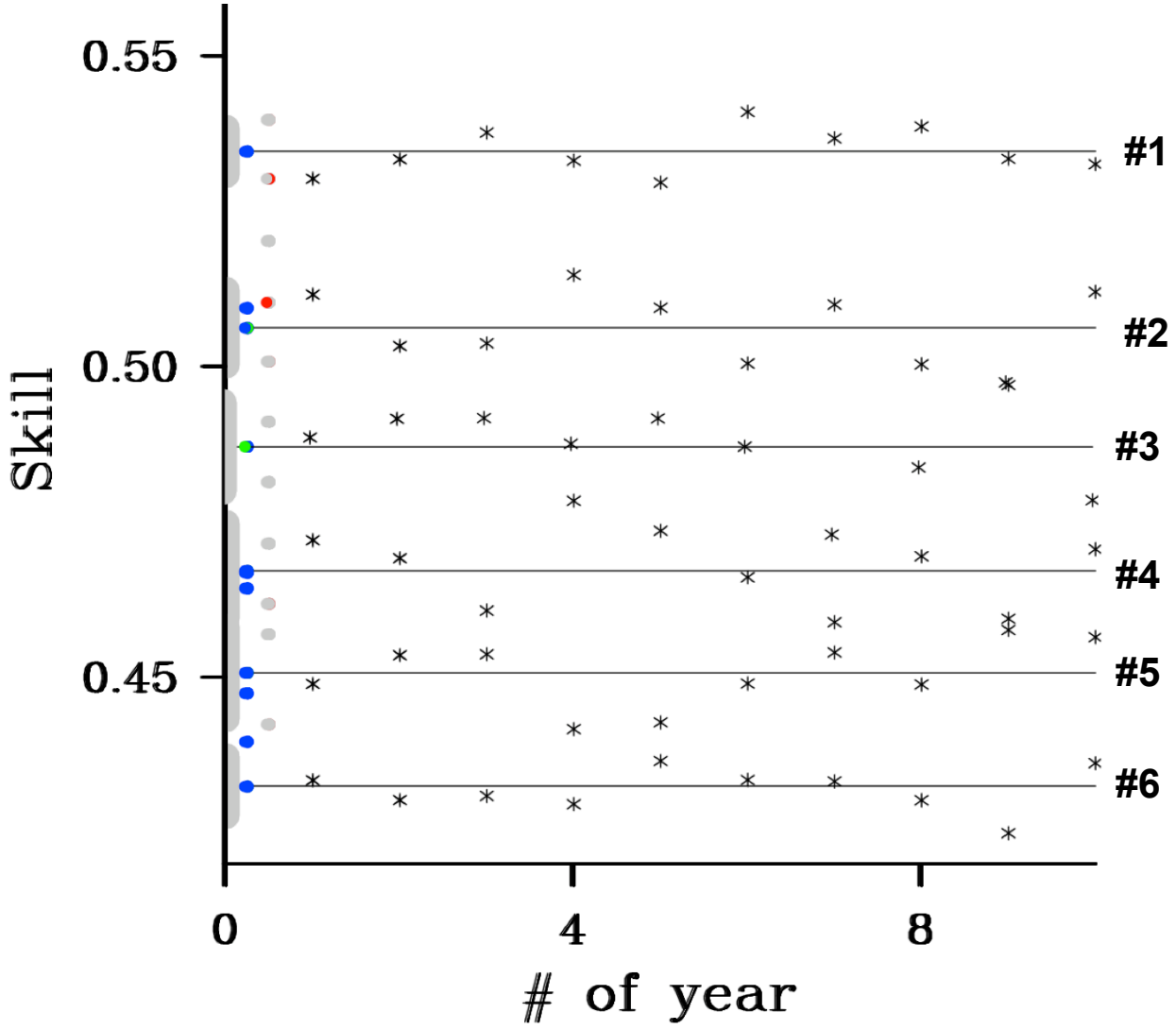
Short wave cloud radiative effect



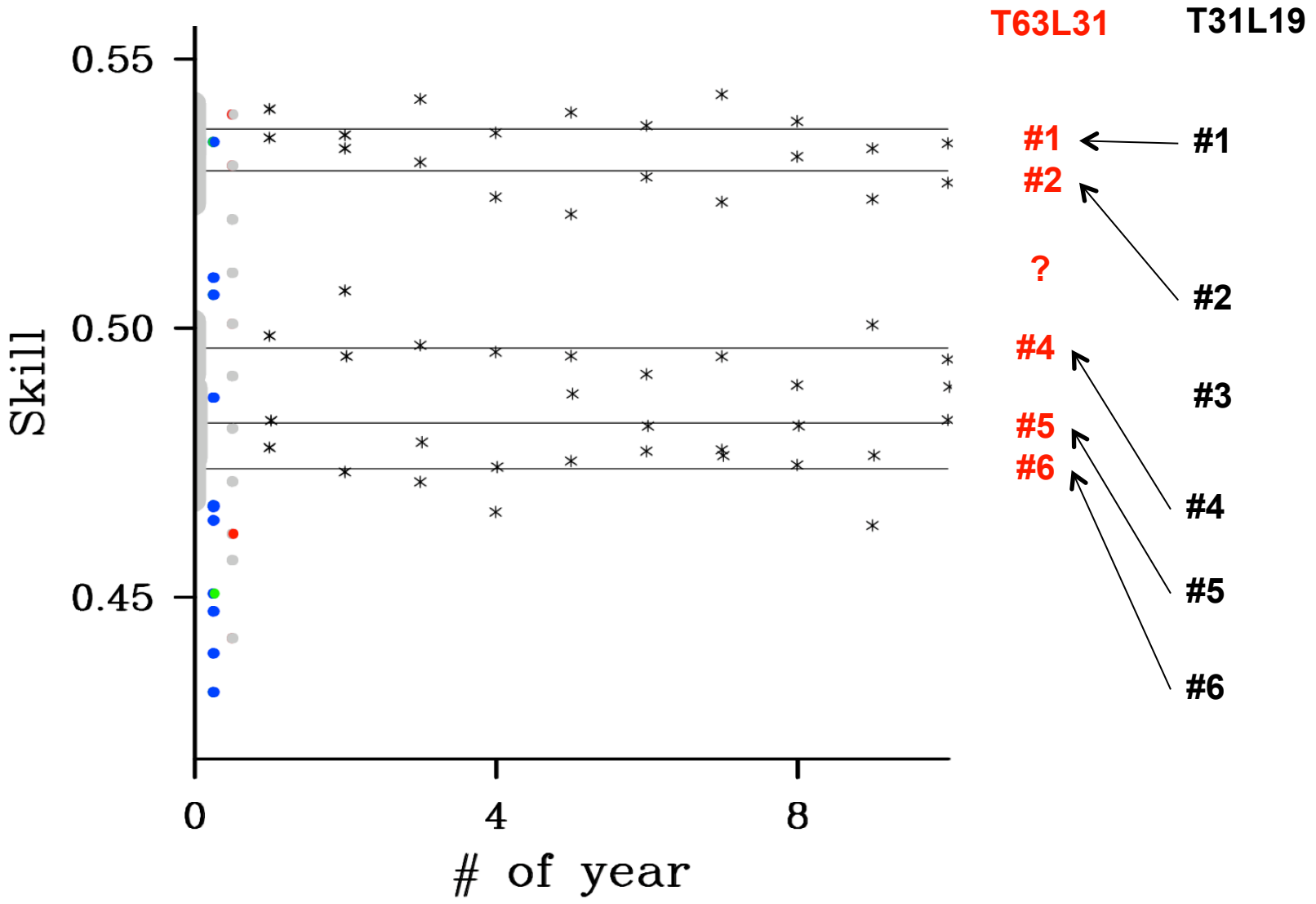
Long wave cloud radiative effect



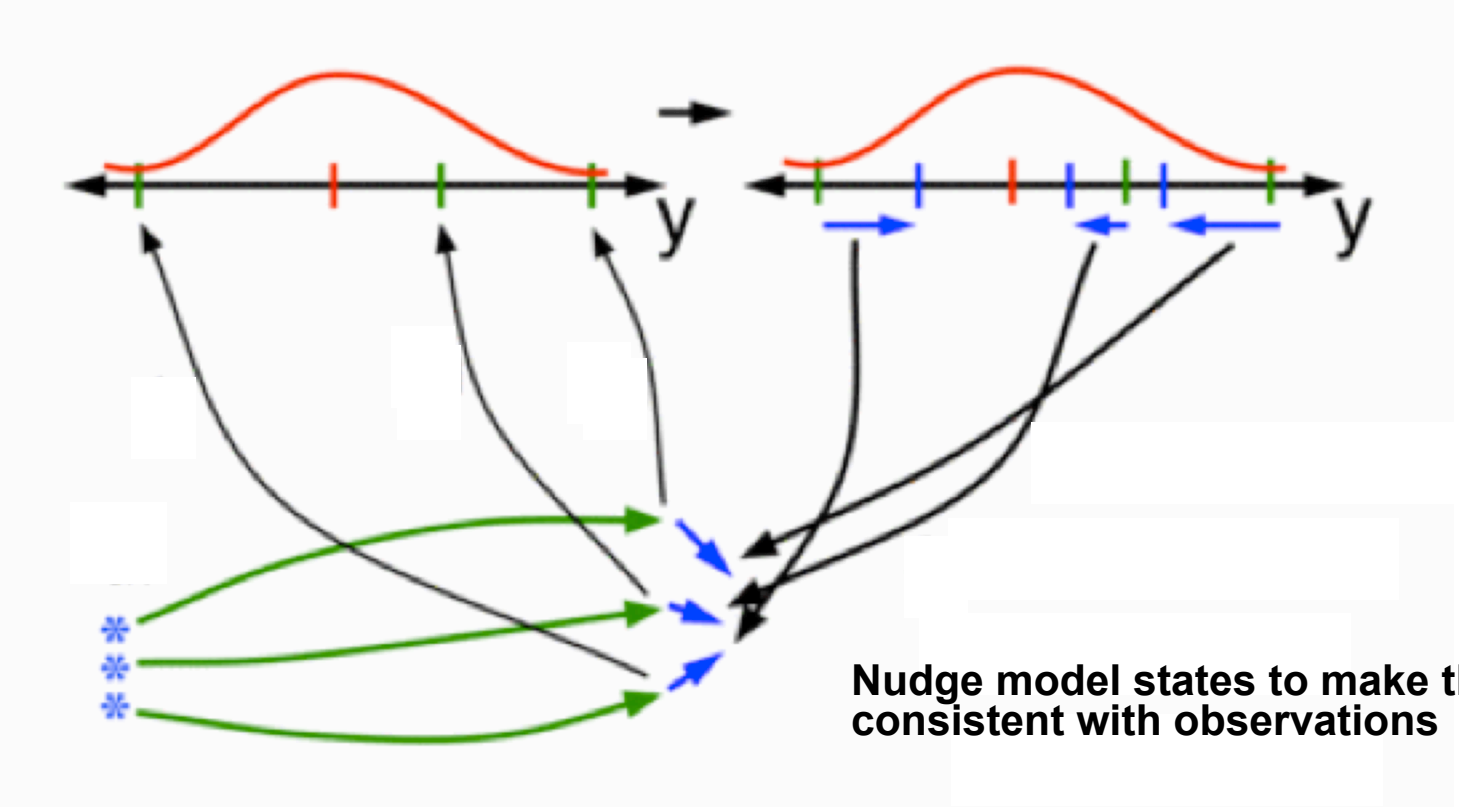
Robust in time?



And with resolution?



Data assimilation

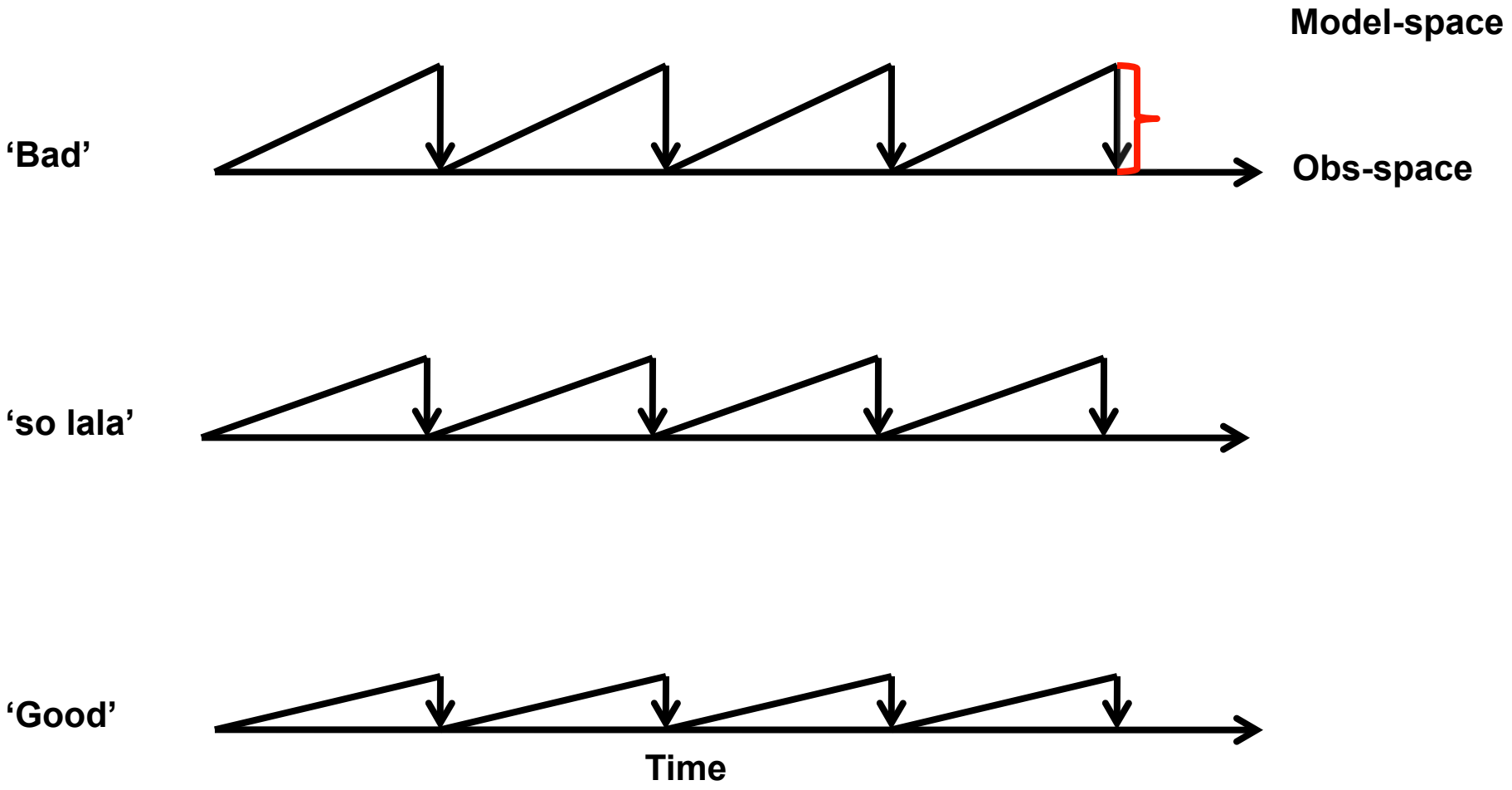


Nudge model states to make them more consistent with observations

Work flow:
Forecasts – expected observations – compare to observation – increments – analysis - repeat

Dart website: www.image.ucar.edu/DAReS/DART/

Links to skill and sensitivity?



Summary

We are investigating a set of perturbed physics experiments focusing on cloud properties.

We are looking for a link of the models skill in simulating cloud properties to assimilation increments, as a measure for fast evolving errors.

For the future: If above successful, we are curious, if there is any connection between fast evolving errors, skill in cloud properties and cloud feedback strength (climate sensitivity).